A Review of Edible Plants in Southwestern Nigeria as Natural Cancer Chemotherapeutic Agents: Implications for Medical Nutrition Therapy

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ABSTRACT

***Background**: Cancer is a growing global health concern, with Nigeria facing a substantial burden of breast, cervical, prostate, liver, and colorectal cancers. In many low-resource settings, conventional therapies are limited by high costs, side effects, and accessibility issues. Consequently, attention has turned toward alternative and complementary approaches, particularly those based on indigenous plant resources. Southwestern Nigeria is rich in edible plants traditionally used for health purposes, many of which show chemotherapeutic potential but remain under-investigated in modern oncology.*

***Objective**: This review evaluates five indigenous edible plants—Solanum aethiopicum, Glycyrrhiza glabra, Solanum tuberosum, Citrus × paradisi, and Cucumis sativus—with emphasis on their bioactive compounds and potential roles in cancer therapy and medical nutrition therapy.*

***Methods**: A systematic literature search from 2000 to 2024 was conducted using PubMed, Scopus, and Google Scholar. Relevant studies were identified focusing on phytochemical composition, pharmacological effects, and ethnobotanical relevance. Data on anticancer mechanisms were extracted and aligned with cancers prevalent in Nigeria.*

***Results**: The review identified several potent bioactive compounds with demonstrated anticancer properties. Solanum aethiopicum contains solamargine, which induces apoptosis in breast and cervical cancer cells. Glycyrrhiza glabra produces glycyrrhizin that modulates Bcl-2 proteins in prostate cancer. Solanum tuberosum's glycoalkaloids (solanine, chaconine) show efficacy against colorectal cancer. Citrus × paradisi contains naringin and limonoids with anti-angiogenic effects in liver cancer, while Cucumis sativus flavonoids modulate inflammatory pathways in prostate cancer.*

***Conclusion**: These plants hold promise for integration into cost-effective, complementary cancer care strategies. However, clinical trials are needed to validate safety and efficacy.*

Keywords: Cancer, Chemotherapy, Edible Plants, Bioactive Compounds, Medical Nutrition Therapy

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INTRODUCTION

Cancer represents a complex group of diseases characterized by the uncontrolled growth and spread of abnormal cells (1). These abnormal cells invade and interfere with surrounding tissues and organs, causing severe health issues (2). Depending on the place of its onset in the body, cancer can be developed diversely, with one another showing de▪nite symptoms, as well as being distinguishable in the outcome or treatment that needs to be applied. Cancer development usually results from a collection of genetic changes or alterations that disturb the proper regulation of growth and division of cells within the body (3). Though cancer causes could be different based on each type and variable, there are shared elements that identify this illness. These causes entail the rapid proliferation of cells, avoidance of the body's immune system, penetration into nearby tissues, spreading to other organs, and promotion of blood vessel development to support tumor growth (4).

Cancer is one of the major global crises threatening healthcare systems all over the world. Nigeria is at the forefront of this ▪ght. It becomes essential to appreciate that Nigeria registers approximately 115,950 new cases and 70,327 deaths per annum due to cancer (5). This brutality in cancer situations mandates the puttingin place effective measures to counter this now second-killer disease in the country. The high incidence of breast, cervical, prostate, liver, and colorectal cancers in Nigeria calls for effective treatments in the health care system(6). Given this, there has been a growing recognition of the role natural products based on traditional knowledge can play in augmenting conventional cancer therapy (7-9). Southwestern Nigeria is rich in botanical diversity, housing a great diversity of edible plants that hold promise for cancer research (10-14). Thus, the present review is about the possible therapeutic bene▪ts of such herbs, particularly those expected to treat some types of cancer in Nigeria(15). Recent trends have shown an upsurge in the use of alternative medicines derived from natural plants in Nigeria (15-20). These therapies have gained popularity due to their availability and cultural relevance, especially with the scarcity and high cost of conventional cancer treatment services. Southwestern Nigeria is abundantly rich in plant species that make it a rich vein for exploration (21,22). This region forms one of the bastions of natural wonder, with history standing uprooted deeply in traditional healing techniques. Nigeria presently records a high burden of life- threatening cancer cases, with 102,000 new cancer cases and 72,000 deaths occur annually (5). It is, therefore, paramount to investigate these plants' therapeutic potentials. Their bioactive chemicals are diversi▪ed and possess potential for explorations in cancer research. The potential of these compounds has been shown to inhibit tumor growth and metastasis, inducing cell death and hindering the formation of blood vessels that support tumor development (23). This review scans the empirical evidence that demonstrated the use peels of edible plants from Southwestern Nigeria as potent modulators of molecular cascades of carcinogenesis.

METHODS

Search strategy

A comprehensive literature search was conducted using multiple academic databases, including PubMed, Scopus, Google Scholar, and Web of Science, to identify relevant studies on edible plants from Southwestern Nigeria with potential anticancer properties. Keywords such as " Solanum aethiopicum," "Glycyrrhizin glabra," "Solanum tuberosum," "Citrus X paradise," " Cucumis sativus," "bioactive compounds," "cancer therapy," "medical nutrition therapy," and "ethnobotanical uses" were used to retrieve articles published between 2000 and 2024. Inclusion criteria were studies that focused on the chemical composition, biological activities, pharmacological effects, and ethnobotanical signi▪cance of these plants in the context of cancer treatment. Studies reporting experimental results, clinical trials, and reviews on the potential of these plants in treating common cancers in Nigeria, such as breast, cervical, prostate, liver, and colorectal cancers, were prioritized. Articles published in peer- reviewed journals were considered, with additional references from bibliographies included to ensure a comprehensive understanding of the topic.

RESULTS

Solanum aethiopicum (Eng: Ethiopian eggplant; Yoruba: Igba)

The Solanum genus belongs to the Solanaceae family, made up of several species known for anticancer activities (24). Solamargine is a steroidal alkaloid glycoside that has been isolated from different species of Solanum, including Solanum nigrum , and shown to exert an anti-cancer effect through numerous biological routes such as tumour suppression and cell survival, caspase activation, mitochondrial function, death receptor signaling, protein kinase activity, and

signal transduction pathways linked to the facilitation of invasion, migration, and resistance to multi-drugs (25,26).

Glycyrrhizin glabra (Eng: sweet wood, Yor: Ori)

Glycyrrhiza glabra root contains bioactive compounds with potential anticancer properties. This compound showed in vitro activities of being signi·cantly cytotoxic tard some gastric, breast, and prostate cell lines (27-30). Glycyrrhizin is said to exert apoptotic activity on cancer cells through various routes. Research has demonstrated that it may alter the activity of many genes that control cell survival and programmed cell death, including the Bcl-2 family of proteins that modulate apoptosis. Further, in addition to the above, glycyrrhizin has also prevented cancer cell proliferation by arresting growth cells at the G1 stage and leading to apoptosis at high levels (31). Glycyrrhizin is also reported to have antiangiogenic properties critical in cancer expansion and progression (32). Studies have shown that it successfully blocks the growth of new blood vessels in tumours, decreasing the supply of oxygen and nutrients to the cancer cells (33).

Solanum tuberosum (Eng: Potato; Yor: Odunkun)

Solanum tuberosum , has been extensively studied for its important anti-cancer properties. Potato also contains a wide range of bioactive compounds, which include phenolic acids, flavonoids, and glycoalkaloids shown to possess potent anti-cancer properties (34). Glycoalkaloids present in potatoes, particularly solanine and chaconine, have been reported to hold down the activity of many types of cancer cells like breast, lung, and colon in widespread reports (35) . The identi·ed phytochemicals were shown to induce apoptosis in cancer cells. It can activate through various molecular pathways (36).

Citrus X paradise (Eng: Grapefruit, Yor: Osan nla)

Grapefruit (Citrus X paradise) is a large, citrus fruit known for its tart and slightly bitter taste. Empirical evidence has shown that Citrus x paradisi and its bioactive compounds possess various powerful molecular mechanisms against cancer. These mechanisms include triggering apoptosis, halting the cell cycle, inhibiting proliferation and angiogenesis, as well as displaying antioxidant and anti- inflammatory properties. Additionally, grapefruithassynergisticeffects with chemotherapeutic agents, further enhancing its potential as a natural anticancer agent (37). Studies have demonstrated that extracts and essential oils derived from grapefruit peels can trigger apoptosis, which is the process of programmed cell death, in several types of cancer cells such as breast, prostate, and glioblastoma cells (38). The apoptotic effects are achieved by regulating crucial signaling pathways, including caspase activation and mitochondrial pathways. Nano and micro vesicles produced from grapefruit have been discovered to cause cell cycle arrest in melanoma cells, namely in the G1 phase and the cell cycle arrest is accompanied by alterations in the expression of oncogenes and cell cycle regulatory genes, including reduced levels of p ERK, p Akt, ICAM-1 , and cathepsin (39).

Cucumis sativus (Eng: Cucumber, Yor: Kukumba)

Cucumis sativus , also referred to as cucumber, is acknowledged for its inherent health advantages, particularly its anti-carcinogenic attributes. Various research has examined the impact of cucumber on different elements of carcinogenesis. The ethyl acetate fraction derived from the blossoms of Cucumis sativus has demonstrated the ability to trigger programmed cell death (apoptosis) in HepG 2 cells, a kind of liver cancer cells found in humans (40).

Table 1 provides a summary of the anticancer potential of edible plants from Southwestern Nigeria, focusing on their bioactive compounds and therapeutic effects. These plants are known for their signi·cant anticancer properties, attributed to the presence of various bioactive compounds such as glycosides, flavonoids, and phenolic acids. The table highlights the mechanisms through which these compounds exert their effects, including apoptosis induction, inhibition of cell proliferation, anti- angiogenesis, and modulation of key signaling pathways. These plants, including Solanum aethiopicum (Igba), Glycyrrhiza glabra (Ori), Solanum tuberosum (Odunkun), Citrus X paradise (Osan nla), and Cucumis sativus (Kukumba), present valuable natural therapeutic options for cancer prevention and treatment, especially in resource-limited settings.

Table 1: Anticancer Potential of Edible Plants from Southwestern Nigeria: A Summary of Bioactive Compounds and Their Therapeutic Effects

Plant	Local Name (Yoruba)	Bioactive Compounds	Anticancer Effects	References
Solanum aethiopicum	Igba	Solamargine, Steroidal alkaloid glycoside	Anti-cancer effects through tumor suppression, apoptosis induction, mitochondrial function, caspase activation, inhibition of invasion, and resistance to multi-drug resistance.	(24, 25, 26, 27, 28, 29)
Glycyrrhiza glabra	Ori	Glycyrrhizin	Induces apoptosis, anti-proliferative activity, Antiangiogenic effects, antioxidant, and anti-inflammatory properties. Enhances efficacy of cyclophosphamide.	(29, 30, 31, 32, 33, 34, 35, 36)
Solanum tuberosum	Odunkun	Glycoalkaloids (solanine, chaconine), phenolic acids, flavonoids	Induces apoptosis, cell cycle arrest, inhibits cell proliferation, suppresses colorectal cancer growth, and promotes cell death.	(37, 38, 39, 40, 41)
Citrus X paradise	Osan nla	Flavonoids (naringin, hesperidin), polymethoxylated flavones, limonoids	Apoptotic effects, inhibition of cell cycle, anti-proliferation, anti-angiogenesis, antioxidant, anti-inflammatory. Enhances the effect of chemotherapy drugs like cyclophosphamide.	(42, 43, 44, 45)
Cucumis sativus	Kukumba	Flavonoids, phenolic compounds	Induces apoptosis, inhibits cell proliferation, antiandrogenic, estrogenic, anti-inflammatory effects. Modulates cancer-related signaling pathways.	(46, 47, 48, 49)

DISCUSSION

In the current study, we reviewed the anticancer mechanism of five different edible plants in south western Nigeria.

These include Solanum sp., Glycyrrhiza glabra, Solanum tuberosum, Citrus X paradise , and Cucumis sativus Notably, varieties of Solanum species have been demonstrated to possess remarkable anticancer bioactivity. The cytotoxicity exhibited by the extracts of Solanum trilobatum fruits against the MCF-7 breast cancer cell line, the antitumor property of the extracts from the leaves of Solanum muricatum on HeLa cells (34), and cytotoxic compounds, such as campesterol isolated from seeds of Solanum capsicoides among others (35). Similarly, it has been

demonstrated that the sesquiterpenoids isolated from Solanum indicum show remarkable cytotoxic activity on various cancer cell lines. Extracts from Solanum lyratum and Solanum betaceum have also been shown to inhibit cancer development and induce programmed cell death in the cancer cells, respectively (36).

Additionally, glycyrrhizin has been found to have antioxidant and anti- inflammatory properties, which are believed to be responsible for its anticancer effects. According to research it has been noted that this substance scavenges free radicals and diminishes oxidative stress; both are recognized as factors for the development and spread of cancer(37). Glycyrrhizin is not only directly an anticancer agent, but it shows synergistic bene·ts when combined with other anticancer medications. For example, it is known to enhance the antitumor activity of cyclophosphamide, which i s a commonly used chemotherapeutic drug, by increasing its bioavailability and reducing its toxicity (38).

The potato extracts contain phenolic acids and flavanoids, which have been known to exhibit anti-cancer characteristics. Moreover, potato extracts have been found to restrain human colorectal cancer cell growth and promote cell death by releasing mitochondria and translocating the proapoptotic protein Bax into the nucleus (39). This is mediated by the activation of caspase-dependent as well as caspase-independent pathways. In addition, the trypsin inhibitor of sweet potato protein (SPP) strongly suppressed the growth, motility, and invasion activity of human colorectal cancer cells in an in vitro model (41)

According to Arafa et al. (42), grapefruit peel extracts include bioactive chemicals such as flavonoids and polymethoxylated flavones, which have been found to hinder the growth of cancer cells and impede the formation of blood vessels in tumours. The inhibition of cell proliferation and the prevention of blood vessel formation are essential in restricting the expansion and advancement of tumours (42). Grapefruit has a high amount of phytochemicals, including flavonoids (such as naringin and hesperidin) and polymethoxylated flavones which have have strong antioxidant and anti-inflammatory activities (44). These properties can contribute to the anticancer effects by reducing oxidative stress and inflammation, which are known to promote cancer development and progression (44). According toresearch conducted by (44), grapefruit bioactive components, such as limonoids, may improve the effectiveness of some chemotherapymedications(such as cyclophosphamide) against tumours (45). This is achieved by enhancing the drugs' bioavailability and decreasing their toxicity. This cooperative impact has the potential to enhance the effectiveness of cancer treatments.

The LD50 (lethal dose for 50% of the cells) of this fraction is measured at 103.7 g/mL, as reported (46). The apoptotic impact plays a crucial role in the anticancer action of Cucumis sativus. According to another study, extracts from Cucumis sativus have been found to hinder the hyperproliferation of prostate cancer cells (47). The observed inhibition of cell proliferation is believed to occur through the actions of antiandrogenic, estrogenic, and anti-inflammatory mechanisms, as indicated by the reduction in levels of IL-1 , IL-6, and TNF (46). The anticancer potential of methanolic and acetone extracts of Cucumis sativus (CSME and CSAE) has been assessed. The extracts possess antioxidant and anti- inflammatory characteristics that exert anticancer bene·ts by mitigating oxidative stress and inflammation, both of which are recognized as catalysts for cancer initiation and advancement (48). Cucumis sativus extracts have the potential to influence important signaling pathways that play a role in the advancement of cancer, such as the ribosome-inactivating pathway (49). Cucumis sativus can impede tumour growth and metastasis by selectively targeting various biological processes (49).

CONCLUSION

The edible plants described in the current study possess signi·cant anticancer bioactivity due to their essential phytochemical pro·les. These compounds can induce cell death, inhibit growth and migration, and modulate key signaling pathways. Indigenous plants in Southwestern Nigeria, rich in flavonoids, phenolic acids, and other compounds, offer a promising source of natural anticancer agents. Incorporating these plants into dietary therapy may enhance conventional treatments, reduce side effects, and improve health outcomes. Further research and promotion of these plants could lead to effective dietary strategies for cancer prevention and treatment in regions with limited medical resources.

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